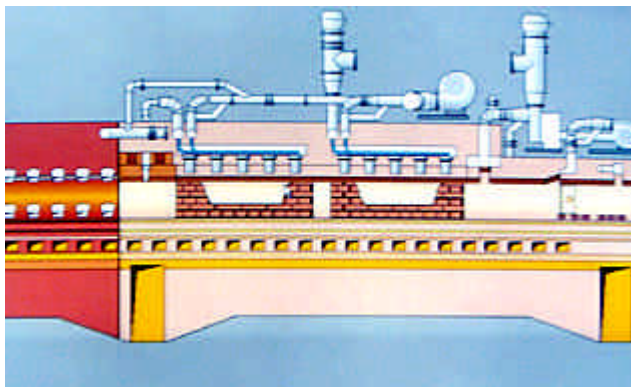


Eco/Energy Audit of an Electric Equipment Manufacturer



Transferable Solution

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Project Title: Conducting an Eco/Energy Audit of Elprom-Elin Plc to identify and assess possible environmental protection and energy conservation measures

Leader: Elprom-Elin, Kubrat, Bulgaria

Partners: 1) Hagler Bailly Services, Inc., Arlington, VA USA and 2) Energy Efficient Systems Ltd., Sofia, Bulgaria

Location: Kubrat, Bulgaria

Project Duration: September 2000 - September 2001

EcoLinks Project Investment: Total EcoLinks Project Investment: \$115,895; EcoLinks Grant Support: \$47,991; Project Team Cost Share Contribution: \$67,904.

Best Practice: Transferable Solution

In this Best Practice, Elprom-Elin, an electrical accessories manufacturer, demonstrates a successful methodology for reducing energy and water consumption and wastewater pollution in Bulgaria. Using a Cleaner Production methodology, Elprom-Elin conducts an eco/energy audit and implements thermal, electricity, and water saving measures including equipment improvements and water recycling. With implementation of the energy and water saving and pollution reduction program, several environmental and economic benefits are accrued: 1) water consumption is reduced by over 50%; 2) electricity consumption is reduced by just over 20%; 3) heavy metals and soluble substances found in wastewater are reduced by 72.5%; 4) and economic savings from these reductions are estimated at \$123,867 per year.

Project Summary

Elprom-Elin is a medium sized firm employing 296 people in Kubrat, Bulgaria. It produces electrical accessories including switches, lamp holders, plugs, and fuses. Elprom-Elin captures both domestic and international markets (more than 15

countries in Europe and Asia). To expand its competitiveness and improve its environmental practices, it must reduce its energy and water consumption and pollution associated with wastewater production.

Energy and water consumption and wastewater production at Elprom-Elin are high. Energy costs comprise 15.6% of total operating costs at Elprom-Elin. The costs of natural gas per unit of production are higher than the average costs for similar enterprises in Europe. The company's operating equipment is inefficient. The lighting and air compression systems are out-of-date and consume large amounts of electricity. The production and distribution of steam could be improved to promote energy savings. The tunnel furnace does not work according to the technology requirements and needs retrofitting. The existing galvanizing line generates a lot of pollution associated with wastewater. Concise and consistent information about energy consumption throughout the plant is not available.

With the support of an EcoLinks Challenge Grant, Elprom-Elin teamed up with an US firm, Hagler Bailly Services, Inc., and Energy Efficient Systems, Ltd. of Bulgaria to implement an energy savings program and apply the principles of Cleaner Production. The specific goals of the project were:

- To train a minimum of 10 people in Cleaner Production and energy efficiency auditing;
- Reduce energy consumption and CO₂ emissions through energy efficiency;
- Reduce waste generation through Cleaner Production measures; and
- Implement no-cost/low cost measures and seek funding for more costly measures.

By implementing the project program, Elprom-Elin generates a savings of \$123,867 per year by reducing energy and water consumption and wastewater pollution. Additionally, wastewater pollutants are reduced by 72.5%.

Project Activities

To improve energy efficiency and reduce water consumption and wastewater production at Elprom-Elin, a complete audit of energy and water consumption throughout the plant was conducted. The results were then used to establish and implement appropriate conservation measures. The following is an itemized list of the methods and materials used to achieve these goals.

1. Conducted workshop on the concept of Cleaner Production

Action: A workshop on Cleaner Production involving ten people was conducted at Elprom-Elin.

Product(s): Trained individuals in Cleaner Production.

2. Conducted eco/energy audit

Action: Collected and analyzed data on energy and water consumption. Developed feasibility and implementation recommendations. General data on the production of metal, porcelain, and plastics was collected. The scope of the audit included a review of the following:

- Energy management system;
- Electricity distribution and consumption;
- Thermal energy distribution and consumption;
- Water distribution and consumption;
- All production lines, technological equipment and administration facilities;
- Installed energy and production equipment; and
- Ecological impact of the production processes.

Areas of the largest consumption of energy and water were identified. As a result of the findings, recommendations for improving energy and water efficiency (e.g., Energy Conservation Opportunities) were developed. Additionally, preliminary market research of potential suppliers of equipment and materials was conducted. Suppliers and installation experts were selected.

Product(s): 1) Data on the consumption of natural gas, electricity and water and the production of wastewater 2) Pre-evaluation assessment report 3) Preliminary list of Energy Conservation Opportunities (ECO) 4) List of suppliers and installation experts for implementation of second - phase measures.

3. Presented results of eco/energy audit and first-phase activity recommendations to plant management

Action: The principle conclusions and recommendations from the eco/energy audit were presented to plant managers. The presentation included information on:

- Objectives and tasks of the project
- Auditing tasks
- Annual energy costs at Elprom-Elin for the year 2000
- Energy savings at Elprom-Elin
- Data on investments and savings
- Greenhouse gas emission reductions
- Natural gas consumption
- High-temperature tunnel furnace
- Thermal losses in steam production and distribution
- Electric energy consumption
- Water consumption and production output
- Energy conservation and environmental opportunities.

Based on this presentation, it was decided that low-cost measures or measures not requiring investments should be implemented in the short-term. Modernization and automation of the tunnel furnace would be initiated using internal financial resources.

Possible sources for financing further energy saving measures were identified. Documents would be prepared and used to apply for funding through the Municipal Energy Efficiency Program (MEEP). This funding was to be used to support the completion of the measures that were categorized as more costly.

Product(s): 1) Final plan to implement energy conservation measures 2) Financing options 3) Application and contract for loan through MEEP.

4. Implemented first phase activities

Action: The following first-phase activities were implemented and evaluated.

Thermal and Electricity Saving Measures:

- Automation of tunnel furnace
- Avoidance of peak tariff zone during furnace operation
- Reparation of air leaks
- Reduction of energy consumption of heated baths.

Water Saving Measures:

- Recycling of water used by light bulb socket presses
- Operation improvement of water cooling tower in the air compressor station
- Reparation of water leaks
- Implementation of improved activities related to plating bath monitoring, maintenance, work flow sequences, plating scheduling, chemical storage and chemical purchase records
- Improvement of plating bath chemistry and operation
- Application of multiple rinse static baths and agitation.

Product(s): 1) Data on energy and water consumption 2) Results based on activation of applied measures from first-phase activities.

5. Conducted seminar on project activities

Action: A seminar involving 48 experts and specialists from various industrial enterprises, energy service companies, power equipment suppliers, and representatives from municipal and state agencies was conducted. The agenda of the seminar was as follows:

- Opening and presentation of the project
- Summary of results of eco/energy audit
- Energy conservation and environmental measures
- Project to retrofit and automate tunnel furnace
- Elprom-Elin participation in Municipal Energy Efficiency Program (MEEP)
- Discussion and closure.

Product(s): Seminar on project deliverables.

6. Continued monitoring and evaluating first-phase energy and water conservation measures; Initiated second-phase activities

Action: Responsible Coordinators were designated by the Executive Director of Elprom-Elin to coordinate energy saving activities including ongoing data collection and the implementation of energy saving measures. Representative data was collected on 1) the results of the application of previously identified energy conservation measures, and 2) related environmental benefits. Monitoring and evaluation procedures were conducted according to the standards designated in the International Performance Measurement and Verification Protocol. It was determined that data would be collected using this protocol for a period of one year to achieve more representative data.

Several second phase activities were initiated. The second-phase measures included:

- Installation of automatic burner and gas-supply line
- Improvement of steam traps and regulators
- Insulation of steam and condensation pipe-lines
- Installation of control system for substations
- Installation of new air compressor.

While several of the second phase activities would require additional financial resources, low cost activities were started. For example, the insulation of steam and condensation pipelines was initiated while installation of a new air compressor was postponed.

Product(s): 1) Designated Responsible Coordinators 2) Additional data on energy and water consumption based on first-phase conservation measures and initiation of second-phase activities 3) Findings and conclusions based on data from implemented activities.

7. Developed guidebook and case study

Action: The project team prepared a guidebook on energy efficiency and Cleaner Production. A case study was produced based on the results of the implemented measures. A visit was made to the headquarters of PA Government Services, Inc. in Arlington, VA. The visit also involved efforts to gather information about equipment suppliers and to exchange information with organizations and experts working on Cleaner Production and energy efficiency.

Product(s): 1) Guidebook 2) Case study 3) Report on the visit to US companies 4) Follow-up plan.

Several benefits are generated when applying the methods and tools described here. Those benefits are discussed in detail in the next section.

These are the methods, tools, and products that make up this project. The next section, "Project Benefits," is an outline of the multiple benefits generated through implementing this methodology.

Project Benefits

The benefits of this project are detailed below. In addition to creating the organizational capacity to implement a Cleaner Production approach to management and production operations, serious reductions in water and energy consumption and harmful emissions provide several environmental benefits and economic benefits from reduced operation costs.

Capacity Building Benefits

With the development and implementation of energy efficient and Cleaner Production measures at Elprom-Elin several capacity building benefits have been generated. Elprom-Elin has built and demonstrated the organizational capacity to implement significant energy and water savings measures and reduce pollution associated with greenhouse gas emissions and wastewater production. Elprom-Elin's experiences have been shared with other interested parties. Through this information-sharing process, Elprom-Elin contributes to strengthening the capacity for other companies to implement similar programs. The following points specify the project's capacity building accomplishments.

- 1) Ten employees and project participants at Elprom-Elin are now trained in the Cleaner Production approach.
- 2) Forty-eight experts and specialists from various industrial enterprises, energy service companies, power equipment suppliers, and representatives from municipal and state agencies participated in a seminar on the project and applied methodologies, and can utilize the methodology to promote energy efficiency and Cleaner Production in other contexts.
- 3) Responsible Coordinators have been designated and trained at Elprom-Elin to carry out data collection and monitoring to continue to promote energy and water savings and wastewater reduction.
- 4) Elprom-Elin created a guidebook and case study that demonstrates to interested parties workable methods and materials for promoting energy efficiency and Cleaner Production in Bulgaria.
- 5) The project collaboration between Elprom-Elin, Hagler Bailly Services, Inc. and Energy Efficient Systems Ltd. established the possibility for future partnerships and technology exchange involving similar efforts.

Environmental Benefits

With the implementation of the full program of measures outlined in this project, the following environmental benefits are gained. Table 1. *Summary of Environmental Benefits* outlines the environmental benefits promoted by this Best Practice. The initial projection of water savings was lower than the savings that were actually achieved in practice. For example, the reduction in water consumption was initially projected to be 4,066 m³/yr, but implementation of the water saving measures revealed an ultimate reduction of 21, 022 m³/yr.

Table 1. Summary of Environmental Benefits

	Actual Situation	Environmental Benefits	Reduction (%)
Reduction of water consumption (and waste water generation)	37,818 m ³ /yr	Reduction of 21,022 m ³ /yr	55.5%
Reduction of electricity consumption	1,246,880 kWh/yr	Reduction of 256,225 kWh/yr	20.5%
Reduction of natural gas consumption	1,299,000 nm ³ /yr	Reduction of 88,000 nm ³ /yr	6.8%
Reduction of porcelain mass rejects	318 kg/yr	Reduction of 73,335 kg/yr	22.8%
Reduction of heavy metals and soluble substances in wastewater	0.3 mg/l Cu; 9.0 mg/l Zn; 3.1 mg/l Ni; Cr ⁶⁺ and 1,552.5 mg/l soluble substances	Reduction of 0.2 mg/l Cu; 8.5 mg/l Zn; 2.9 mg/l Ni, Cr ³⁺ ; and 552.5 mg/l soluble substances	72.5%
Reduction of rejects from final production	54,3000 kg/yr	Reduction of 543 kg of rejects	1.0%

The expected electricity energy savings lead to a 20.6% reduction in polluting emissions. Table 2. *Total Reduction of Emissions* compares emissions reductions before and after program implementation.

Table 2. Total Reduction of Emissions

Results of Implemented Measures	Base Production (tons/year)		Reductions with Program Implementation (tons/year)		Total Reduction of Emissions (%)
Emissions	SO ₂	81.4	SO ₂	17	20.6 %
	NO _x	11.6	NO _x	2	
	CO ₂	1,300	CO ₂	269	
	Ash	3.8	Ash	1	

With these reductions in consumption and emissions, certain economic benefits are derived. For example, costs associated with resource consumption are reduced. The economic benefits of this project are presented in the next subsection.

Economic Benefits

With the implementation of energy and water saving measures based on the eco/energy audit conducted as part of this project, several economic benefits are gained. For example, energy and water costs at Elprom-Elin are reduced by 15% due to lower consumption from improved efficiency. Table 3. Savings Generated from Reduced Energy and Water Consumption outlines the savings generated from implementing energy and water saving measures.

Table 3. Savings Generated from Reduced Energy and Water Consumption

Item	Consumption in 2000 -- Before Energy and Water Saving Measures	Consumption -- After Energy and Water Saving Measures (units)	Energy/Water Consumption Reduction (%)	Annual Cost --Before Energy and Water Saving Measures (\$/yr)	Annual Cost --After Energy Saving Measures (\$/yr)	Savings (\$/yr)	Savings (%)
Water (m ³)	38,000	17,000	55.5	19,000	8,500	10,500	55.5
Electric Energy (kWh)	1,250,000	990,700	20.5	50,000	39,750	10,250	20.5
Natural Gas (nm ³)	1,300,000	1,212,000	6.8	130,000	121,160	8,840	6.8
Total	--	--	--	199,000	169,910	29,090	15

Full implementation of the activities outlined in this project requires a degree of investment. The investment requirements are outlined below in Table 4. Summary of Investments and Savings. The savings generated from implementing each reduction effort are also listed.

Table 4. Summary of Investments and Savings

	Investment (\$)	Savings (\$/yr)	Payback Period (years)
Reduction of water consumption & implementation of additional environmental improvements	\$157,905	\$36,177	4.4
Reduction of electric energy consumption	\$38,974	\$12,880	2.8
Reduction of thermal energy consumption	\$79,905	\$29,061	2.7
Product recuperation	\$22,510	\$59,214	Immediately
Total	\$299,294	\$138,235	2.2

The benefits accrued from this project support its designation as a Best Practice. This next section provides insights and experiences gathered from the practical application of the project methodology.

Lessons Learned

There are both opportunities and challenges in implementing this project. They are listed below to benefit those interested in implementing similar efforts in their regions.

- Presenting the eco/energy audit to company managers allowed for important brainstorming in terms of generating financial resources for implementing program recommendations.

- It is useful to establish a coordinating body that oversees ongoing energy and water data collection and analysis. This body assures the availability of constant feedback on the effectiveness of energy and water saving measures.
- Having the local project leader head the project with the partners acting as guides was especially beneficial as the project leader who is generally on-site has better knowledge about the context (“lay of the land”) and how to avoid pitfalls and communicate more effectively with contacts. Also, as they lead the project, they learn more implementing the new program.
- The trip to the United States to make additional contact with the private sector was especially useful as it provided concrete examples of the project methodology.
- Project efforts can take longer than planned.
- Small projects such as this one tend to take less importance but more time. The bookkeeping and recording activities can be especially time-consuming and should be reduced to the extent possible.

Contact Information

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